SECTION 968
MODIFIED MARSHALL MIX DESIGN METHOD FOR IN-PLACE COLD RECYCLED ASPHALTIC BASE

968.1 Scope

This method covers the design of in-place cold recycled asphaltic base mixtures using Marshall apparatus.

968.2 Apparatus

See AASHTO T 245 for requirements.

968.3 Test Specimens

968.3.1 Number of Specimens - A minimum of three test specimens shall be prepared for each combination of RAP and emulsion content. In addition, one loose sample shall be prepared for each combination of RAP and emulsion content for determination of the maximum specific gravity.

968.3.2 Preparation of RAP - Samples of the RAP shall be obtained from the roadway to the depth specified for cold recycling. Samples should be obtained, if practical, by cold milling. If cores that are crushed are used to obtain RAP samples then a verification is recommended on the actual mix produced during the initial day's cold recycling.

Dry at 230EF a portion of a separate sample of the RAP to a constant mass to determine the moisture content.

968.3.3 Mixing, Compacting and Testing Temperatures - All mixing and compacting testing temperatures shall be 77E F.

968.3.4 Preparation of Mixes

968.3.4.1 Screen the RAP sample over a 1 in. sieve. Reduce the size of the materials retained on the 1 in. sieve to 100% passing the 1 in. sieve by crushing that does not produce excess fines.

968.3.4.2 Weigh, into individual pans, sufficient RAP (approximately 1150 g) to fabricate 4 in. diameter by 2.5 in. height specimens and heat at the mixing temperature for 1 hour in the oven.

968.3.4.3 Place in a mixing bowl and add sufficient mixing water to each sample to achieve a 3% total water content by dry weight of RAP as indicated below.

% Emulsion Water + % Water Remaining in RAP + % Mixing Water Added = 3.0%.

968.3.4.4 Mix the samples thoroughly by hand for 1 minute after adding mixing water.

968.3.4.5 Add asphalt emulsion heated to 140E F at varying amounts to the samples to achieve emulsion contents of 1.0%, 1.5%, 2.0% and 2.5%, while maintaining 3.0% total water content requirement.

968.3.4.6 Mix the samples thoroughly until the asphalt emulsion is uniformly dispersed to 2 minutes.

968.3.5 Compacting of Specimens

968.3.5.1 Preheat the molds at 140E F for one hour.

968.3.5.2 Fabricate a minimum of three 4 in. x 2.5 in. specimens for each emulsion content, applying 50 blows per specimen face using the Marshall compacting hammer.

968.3.5.3 Cure the specimens in their molds in a forced draft oven for 6 hours at 140E F.

968.3.5.4 After oven curing, remove the molds and lay them on their side and allow to cool at room temperature overnight before extruding them from the molds.

968.3.6 Specimen Bulk Specific Gravity (AASHTO T 166, Method A).

968.3.6.1 After the specimen has cooled to room temperature, record the dry mass, A.

968.3.6.2 Immerse the specimen in water at 77E F for 3 to 5 minutes and record the immersed mass, C.

968.3.6.3 Remove the specimen from the water, surface dry by blotting with a damp cloth and determine the surface-dry mass, B.

968.3.6.4 Calculate the specimen bulk specific gravity as follows:

Bulk Specific Gravity = A ÷ (B - C)

968.4 Testing Procedure

968.4.1 Bring the prepared specimens to the specified test temperature by placing them in a forced draft oven for 2 hours. Do <u>not</u> place the specimens in a water bath to maintain the test temperature.

968.4.2 Test the samples for stability and flow in accordance with Sections 4.1 and 4.2 of AASHTO T 245.

968.4.3 Select an optimum emulsion content based on evaluation of stability and flow test results. Evaluate the mixture for the highest stability, similar to what is done in the standard Marshall procedure for hot mix asphalt. At the optimum emulsion content, determine the maximum specific gravity in accordance with AASHTO T 209.

968.4.4 At the selected optimum emulsion content, fabricate 3 specimens each at total water contents of 2.0%, 2.5%, 3.0% (use previous results), 3.5% and 4.0%, using the procedures previously described. Determine the average void content for each percentage.

968.5 Report

968.5.1 The report should include the following:

- Specimen Height
- Specimen Mass
- Specimen Maximum Specific Gravity
- Specimen Bulk Specific Gravity
- Mixture Void Content
- Mixture Stability (lbf)
- Mixture Flow (0.10 in.)
- Average of Bulk Specific Gravities Per Emulsion Content
- Average of Void Contents Per Emulsion Content

968.5.2 **Recommended Mix Design Parameters**

	Minimum	**Maximum**
Design Voids, VTM	**9**	**14**

968.5.3 Mixture Design Recommendations

- Recommended Residual Binder Content, based on the RAP binder content.
- Recommended Emulsion Content
- Recommended Mixing Water Content